National Aeronautics and
Space Administration

technology solution

Power Generation and Storage

Self-Regulating Control in Fuel Cell Systems

Simplifying control strategies with load-dependent voltage

This Johnson Space Center (JSC) innovation is a method for efficiently controlling parasitic power in fuel cell systems. Parasitic power refers to power required for internal system operation rather than for the system's primary purpose of net power output. Originally designed for spacecraft, this novel method employs a simple self-regulating control design that does away with overly complex control strategies and external power controllers, such as electronic power control units, sensors, and thermostatic controllers. In situations where efficiency and reliability are crucial, this innovative method simplifies and reduces operating costs for fuel cell power systems.

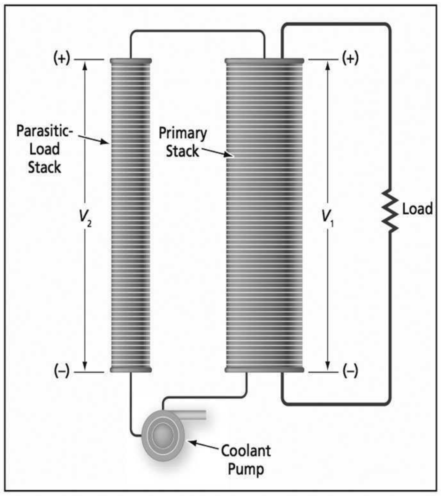
BENEFITS

- Efficient: Boosts power output by making parasitic load self-regulating
- Simple: Eliminates the need for complex control strategies
- Reliable: Optimizes parasitic load control without an external power source
- Cost-Effective: Conserves power by adjusting parasitic loads proportional to need

THE TECHNOLOGY

The method takes advantage of the operating characteristics of fuel cell stacks, particularly the fact that voltage drops off with increasing current density in greater extremes than with battery cells. In one configuration, the innovation uses two or more fuel cell stacks in parallel. Between the negative ends of the fuel cell stacks, a device that is to be controlled from a parasitic power standpoint is placed with its positive electrical power input feed from the negative terminal of the primary stack. The negative output terminal of the parasitic powered device is attached to the negative terminal of the parasitic power stack (see Fig. 1).

As the electrical power output of the fuel cell system increases, the voltage of the primary stack decreases as a function of the voltage versus current density response of the particular fuel cells incorporated into the primary stack. Given the operating characteristics of a system as shown in Fig.1, as the primary stack voltage decreases with increasing load, the voltage difference between the negative end of primary fuel cell stack and the negative end of parasitic fuel cell stack will correspondingly increase, resulting in more current flow through the parasitic device. By carefully selecting cell stack areas, numbers of cells in the two stacks, and resistance of the parasitic power device, the system will operate in a self-regulating, load-following manner.



The voltage applied to the coolant pump (V2-V1) would increase as V1 decreases with increasing current through the load.

Potential application in fuel cell critical power systems.

APPLICATIONS

The technology has several potential applications:

- Cars, buses, and material handling vehicles (such as forklifts) that run on fuel cells
- Distributed energy storage systems for Smart Grid applications
- Next generation alternative energy applications
- Telecommunications back-up systems
- Deep-sea oil drilling operations
- Uninterruptible power supplies
- Fuel cell critical power systems where reliability and efficiency are primary concerns (such as military vehicles, aircraft, and undersea vehicles)

PUBLICATIONS

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More Information

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